



## Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at <http://about.jstor.org/participate-jstor/individuals/early-journal-content>.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact [support@jstor.org](mailto:support@jstor.org).

## THE DISTRIBUTION OF PLANTS IN NORTH AMERICA

A COMPREHENSIVE account of the phytogeography of North America has long been a desideratum, and it will be welcome news to botanists that this need has at last been filled. The work of Dr. Harshberger,<sup>1</sup> just issued, is an imposing volume, which will be quite indispensable to all students of plant distribution, and evidently represents an enormous amount of labor on the part of the author. A fair criticism that might be made is that it perhaps is too comprehensive. The book in the writer's opinion could have been very considerably reduced in volume without lessening its value, by drastic cutting of the first three parts, which are really introductory, and yet take up nearly half the book. The really essential facts concerning the geology, geography and climatology of North America could certainly have been presented in much less space. There is much needless repetition, and the arrangement of the topics is at times very confusing.

In addition to Dr. Harshberger's own work there is a summary of the book, sixty-three pages in extent, written in German by the editor of the series, Professor O. Drude.

It is the fourth section of Dr. Harshberger's book which will undoubtedly be of most value to the average botanical student. This deals with the North American phytogeographical regions, formations and associations, and comprises an account of the floras not only of the whole North American continent, but of the West Indies as well.

Nearly one hundred pages are devoted to the history of work published on the floras of various parts of North America, the bibliography alone comprising forty-six pages. This makes up Part One of the work. The second part—Geographic, Climatic and Floristic Survey—occupies seventy-seven pages. In this section are given very much in detail an immense body of facts, many of which could have been omitted without materially lessening the value of the summary. Nevertheless it contains very much that the student will find exceedingly useful.

This section makes very clear the great range of conditions on the North American continent, which explains the richness and variety of its flora. Very full statistics are given in this chap-

<sup>1</sup> "Phytogeographic Survey of North America," John W. Harshberger, "Die Vegetation der Erde," Vol. XIII.

ter, including many tables, temperature, rainfall, etc. From the eternal ice and snow of Greenland to the equatorial conditions on the Isthmus of Panama, practically the whole gamut of climate depending upon latitude is covered. Moreover, the great variety in topography in North America results in precipitations ranging from practically nothing in the extreme deserts of the arid southwestern United States and Mexico, to a rainfall of two hundred inches or more in some tropical regions like parts of Jamaica.

The presence of lofty mountains permitting a rich Alpine flora in the northwestern parts of the United States and Canada, is also an interesting feature of the vegetation of North America. In his division of the phytogeographical regions Harshberger recognizes four main divisions: Northern, Central, Southern and West Indian. The United States lies almost entirely within the second of these, only the region of the Great Lakes and a small area in the Gulf region encroaching respectively upon the northern and southern zones. The natural phytogeographical areas, however, are by no means determined by latitude alone, this being especially the case in the central zone, where there are several quite unrelated floristic regions lying in practically the same latitude. Such, for example, are the eastern forest area and the western Cordilleran region.

The pronounced continental climate of the great plains, with its yearly range of temperature from arctic cold to tropic heat, may be contrasted with the uniform mild climate of the Pacific Coast, where longitude plays quite as important a rôle in determining the distribution of plants as does latitude. For example, Victoria in latitude 48 has a mean temperature for January of 41.9° F., while St. Louis, almost 10° further south, is 12 degrees colder. This illustrates the differences in the conditions between the Pacific Coast region and the pronounced continental climate of the Middle West.

The southern area, including Mexico and Central America, is for the most part tropical in its climate, except for the temperate uplands of Mexico. Within the United States, Florida and the southernmost tier of states adjacent to Mexico, really belong to the southern area rather than to the central one.

In the third part of his volume Dr. Harshberger treats at great length the geologic history of North America, and its bearing upon the origin and distribution of the present flora. In

the course of this section he expounds his own views as to the origin of the North American flora, and the factors which have brought about its present distribution. While this section contains much important and interesting material, it can not be said that its arrangement is all that could be desired. After a perusal of the 174 pages contained in it, there is left in one's mind a very confused impression of a conglomeration of geology, phytogeography, and the origin of floras, together with other more or less disconnected topics. A large part of this section deals again with the phytogeographical areas already discussed at length in the previous section, and repeated in the fourth part of the book, but deals with them from the standpoint of centers of distribution rather than merely from latitude. It is to be regretted that the subject of the phytogeographical areas has not been treated as a connected whole, and also materially reduced, so as to bring out the salient points, instead of presenting a mass of details of very varying importance.

While, as might be expected, the plants treated are for the most part the flowering plants, still the lower plants are not entirely neglected, the Algæ especially coming in for a fuller treatment than is usually accorded them in works on plant distribution.

As the flowering plants, especially Angiosperms, are the predominant plants of the existing land floras, the geological history of the country before the Cretaceous is of relatively small importance as bearing upon the distribution of the existing vegetation, since it is not until the Cretaceous, or at the earliest the Sub-Cretaceous is reached, that recognizable remains of Angiosperms are met with. Professor Harshberger gives an excellent account, with maps, of the distribution of land and water areas during the Cretaceous and their significance as affecting the future distribution of North American plants.

During the lower Cretaceous a solid land mass occupied approximately the present area of North America, but was separated from South America by a wide gap through what is now Central America, allowing free communication between the Atlantic and the Pacific. At that time also there was still a broad land connection with Western Europe. Throughout the northern area both of the old and new world, it is evident that a very uniform vegetation flourished, with Conifers as the predominant trees.

During the later Cretaceous extensive changes took place. The great western mountain chains were thrown up and communication with South America was established; but there was a complete separation of the eastern and western land masses. A broad body of water extended without interruption from the Arctic Ocean to the Gulf of Mexico, and the whole of the great plains region to the east of the Rocky Mountains was then submerged. Professor Harshberger believes that this was the period which determined the separation of the Eastern and Western coniferous floras, and the foundation of the great differences in the general floral characters of Atlantic and Pacific North America.

The Cretaceous is notable in the history of the vegetable kingdom as the time when the highest types of plants first appeared, or at any rate when they are first recognizable. There are no certain evidences of Angiosperms previous to the Sub-Cretaceous. Apparently the Cretaceous was a period of great development of new plant forms, perhaps conditioned by the great changes in the physical character of the continent, these changes undoubtedly causing great changes of climate as well. Harshberger thinks that the Cretaceous was probably characterized by periods of mutation—used in the sense of De Vries. Whatever may have been the reason, during the Cretaceous most of the modern angiospermous types, and many of the living genera appeared. The great feature of the later Cretaceous and Tertiary forests was the preponderance of dicotyledonous trees and shrubs whose remains are found in great numbers. It is certain that many existing herbaceous genera must also have been present, but with rare exceptions these have not been preserved as recognizable fossils, no doubt owing to their perishable tissues which were not fitted to leave fossil remains except under exceptionally favorable conditions.

The high northern extension of the Cretaceous and Tertiary forests, especially in the Miocene, shown by the fossil deposits as far north as Greenland and Spitzbergen, indicates a relatively warm climate for these higher latitudes of the northern hemisphere. Moreover this northern forest belt seems to have been much the same throughout the whole extent of the northern hemisphere, very many species occurring both in the eastern and western hemisphere. Many of the most characteristic of the Miocene genera still exist in America, especially in the great

deciduous forest region of the southern Appalachians. Among the widespread Miocene genera which still exist in America may be mentioned Magnolia, Liriodendron, Vitis, Sassafras, Aralia, Nyssa. Indeed it is supposed that some of the Miocene species still survive. Among these are the southern Cypress (*Taxodium distichum*), Balsam Poplar (*Populus balsamifera*), Sweet Gum (*Liquidambar styraciflua*), Black Walnut (*Juglans nigra*) and many others.

With the redistribution of the forest flora due to the glacial epoch, many of these types disappeared from western America and Europe but have survived in eastern America and eastern Asia. It is clear also that genera now confined to the Old World also existed at that time in North America. A long list of the Cretaceous and Tertiary genera of North America shows, for example such extra-American genera as Banksia (Australia), Casuarina (Australia and Malaysia), Encephalartos (South Africa), Eucalyptus (Australia), Ginkgo (China), Hedera (Europe, Asia), Sterculia (tropics of the Old World and Australasia).

During Tertiary times the eastern and western parts of the continent were again united, and there seems to have been a fairly uniform northern flora throughout the Atlantic and Pacific regions, although the separation of the Atlantic and Pacific floras was already indicated, the difference in climate no doubt being influenced by the changes in elevation caused by the uplifting of the great western mountain masses, inducing a drier climate in the interior of the continent. It seems probable that to the north of the great forest belt extending across the continent was an arctic flora, remnants of which are found in the Alpine regions of the higher mountains where they presumably took refuge after the migrations subsequent to the great glacial epoch.

It is pretty generally agreed that the present distribution of plants in America is mainly the result of the advance of the great glacial sheet from the north. In the southward retreat of the great forest belt there was a division which, it has been suggested, was caused by the presence of the dry plains of the interior, which were unfitted for forest growth, and thus acted as a wedge separating the western forest, predominantly of coniferous trees, from the eastern forest mainly deciduous in character. Whether or not this is the true explanation, the fact

remains that at present the western forest is composed in the main of a great variety of coniferous trees adapted to dry summer conditions, while the eastern forest is distinguished by its great richness in deciduous trees adapted to a humid summer climate. Close to the retreating line of the forests, there presumably followed a belt of arctic vegetation clinging to the edge of the advancing glaciers.

With the retreat of the glaciers the plants advanced northward again, and the present distribution was finally established. Owing to the much greater altitude of the western mountains, it is especially upon these that we find a true Alpine flora, the more or less changed remnants of the arctic vegetation forced southward by the advancing ice sheet. It is true that a few arctic plants, like the Greenland sandwort, occur upon the highest peaks of the Appalachian system, but the number of these is comparatively insignificant when compared with the rich and beautiful Alpine flora of the Canadian Rockies and the Cascades.

At the close of the glacial epoch the distribution of the plants was practically as at present, the most marked features being the eastern and western forest areas and the great open region of the great plains.

Part four deals with the floral regions as they now exist in North America. Probably most botanists will feel that the weakest feature of this account of the flora of North America is its lack of proportion. While the relatively uniform flora of the Atlantic half of the continent receives over 150 pages, the Rocky Mountain flora is dismissed with 23 pages, and the extraordinarily varied and interesting flora of the Pacific Coast with less than fifty. This no doubt is to be explained by the author's very intimate acquaintance with the flora of the Atlantic states, and his evidently very casual observations at first hand upon that of the western third of the continent; but he has not shown the best judgment in the selection of topics for discussion, dealing at great length with relatively very unimportant regions. Nearly as much space is given to a discussion of the pine-barren flora of the Atlantic Coast states as to the whole of the Pacific Coast from Alaska to Mexico. The multiplication of details in the discussion of the floras of small and unimportant areas, results in a general sense of confusion, and one is often at a loss to see the bearing of many of the detailed descriptions of local floras upon the larger problems. It is a pity that the abundant

materials had not been better digested, and much might just as well have been omitted. The contrast between the over-elaboration of many topics dealing with the Eastern flora, and the very casual treatment of the far more important and divergent conditions of the Rocky Mountain and Pacific region, is both striking and regrettable. However, with all these serious faults, the patient reader will be able to get a fairly comprehensive view of the extremely diverse features making up the flora of the North American continent.

With the last retreat of the great ice sheet, there moved into the territory thus uncovered plant migrants from various sources. Keeping close to the retreating ice sheet are the various strictly arctic or glacial types, and south of this northernmost flora is the extensive development of bog and tundra formations, which form so important a feature in the arctic and subarctic regions of Alaska, Canada and Greenland.

This northern area in America shows three sections, ranging from east to west. Greenland, separated from the mainland by the deep water of Baffin's Bay and Davis Strait, belongs really with Europe, its scanty flora being composed almost exclusively of European types like those of Scandinavia and Lapland. The middle region extending from Labrador to the Mackenzie River is marked by a larger preponderance of purely American types. Westward, including Alaska, the arctic flora is again characterized by a preponderance of Old World species. Out of 364 species of Western Arctic America no less than 320 occur in Northwestern Asia, many of them extending southward to the Altai and Himalaya Mountains. Of the 379 species belonging to the middle region 73 species are strictly American, the other 306 occur also in the arctic regions of the Old World.

The characteristic "tundras" are plains whose subsoil is permanently frozen, but whose surface soil is covered with a dense growth of mosses or lichens, among which grow in places dwarf Alders, Willows, Birches, and various ericaceous shrubs, *e. g.*, Cassiope, Andromeda, *Vaccinium*, *Ledum*, etc., as well as many herbaceous plants, some with showy flowers like the Iceland poppy. It is evident that the arctic flora is remarkably uniform throughout the whole northern hemisphere.

In connection with a study of the land plants some interesting features may be noted in regard to the arctic American Algæ. There is a remarkable difference between the Algæ of the

arctic regions of the Atlantic and the Pacific, many striking genera including the giant Kelps being quite unrepresented on the Atlantic side of the continent. Harshberger thinks that this points to these two regions as being distinct centers of development and distribution, and it may also show that some of the extraordinary Kelps of the Pacific Coast may be relatively recent developments.

South of the arctic zone is a sub-arctic forest zone, also of very similar composition throughout its whole extent from Labrador to Alaska. This forest is largely composed of Conifers, the predominant trees being White and Black Spruce, Balsam-Fir, Tamarack and Scrub pine.

With the Conifers are associated Aspens, Balsam Poplars, Willows, Alders and Birches. Swamps and peat bogs abound and in these as well as in the forest itself grow many attractive shrubs and herbaceous plants. Ericaceous shrubs are especially abundant, *Rhododendron*, *Kalmia*, *Ledum*, *Vaccinium*, etc., as well as wild Roses, species of *Rubus* and *Ribes*, etc. In the Sphagnum bogs, especially in the eastern portions, are found Pitcher plants, Sundew, and several beautiful Orchids. A considerable number of species, *e. g.*, *Pyrola rotundifolia*, *Linnaea borealis*, *Cornus Suecica*, are identical with Old World species, and most of the genera, although not the species of trees, are the same.

To the southward of this uniform forest zone a greater divergence in the floras is noted, and within the United States the character of the vegetation changes radically as one proceeds from the Atlantic seaboard westward.

The whole of the eastern third of the United States may be said to comprise one great phytogeographical area, although of course there are certain regions where the flora has a more or less marked type of its own. Nowhere within this area are the mountains of sufficient elevation to form barriers against the ready migration of plants, and the whole region is one of abundant rainfall. The whole area being continuous, the result is a very uniform flora, when contrasted with the Pacific side of the continent. Many species of trees, *e. g.*, Elms, Oaks, Walnuts, Hickories, etc., occur throughout the range and the same is true of very many herbaceous plants. It is true that the number of species is much greater in some parts than others, owing to more favorable conditions of soil and temperature, but there are

no such radical differences within the area as those, for instance, between the Southern California desert and the Redwood belt of the coast region of the same state. The most important feature of this Eastern area is the great development of the dicotyledonous forest trees. Probably nowhere outside the tropics is to be found a richer forest flora, and the trees, both by their size and variety, constitute a truly magnificent forest. This forest reaches its finest development in the Southern Alleghenies of western North Carolina and in parts of the Ohio and Mississippi Valleys. Unlike the northern forest belt and the forests of most parts of Europe, this forest is composed of a great many species intermingled. It is stated by Harshberger that probably the richest forest vegetation in the north temperate zone is found in the lower Wabash Valley in Illinois, where one hundred and seven species of trees occur. In an area of less than a square mile in extent seventy-five species of trees were counted.

While many of these trees belong to European genera, *e. g.*, Poplar, Beech, Birch, Oak, Elm, Ash, etc., many genera are absent from the European forests. Such, for example, are the gums (Liquidambar and Nyssa), Magnolias, Tulip trees (*Liriodendron*), Hickories, Locusts (*Gleditschia* and *Robinia*), the Cypress (*Taxodium*), etc. Some of these trees reach really gigantic size, in regard to which Harshberger gives some striking figures. Thus a Red Oak is cited which was seven feet in diameter, with a height to the first branch of ninety-four feet, and a total height of one hundred and eighty-one feet. A White Oak and Bur-Oak of nearly equal size are mentioned, while a Cottonwood (*Populus monilifera*) was eight feet in diameter and one hundred and ninety feet in height. Thus it will be seen that some of the Eastern deciduous trees almost rival the Pacific Coast Conifers in size. Other giants of the eastern forest are the White Pine, the Sycamore and Tulip tree. With these are associated many shrubs and climbing plants, as well as a characteristic flora composed of herbaceous plants, usually flowering in the early spring before the leaves appear upon the trees.

In the Mississippi Valley the forest is almost exclusively composed of deciduous trees, but in the Appalachian forest there is a mixture of coniferous trees, especially Pines and Hemlocks, while in the north the proportion of these Conifers increases and at the same time many of the deciduous trees disappear, and the forest then consists of a comparatively small number of spe-

cies. In many parts of the northern states there is a preponderance of Beech and Maple, with a comparatively small number of other trees growing with them, but nowhere in the real forest area do we find the pure forests of Beech or Oak which are common in northern Europe.

In marked contrast with the preponderance of deciduous forests over most of the eastern states, are the areas known as Pine-barrens, characterized in certain districts by an almost pure forest of Pines, usually of a single species. Professor Harshberger gives a very exhaustive account of the Pine-barren flora, which he has evidently studied with great care.

At the north the prevalent Pine is *Pinus rigida*, with which are found associated some scrub oaks, Nyssa, Liquidambar, Sassafras and others, as well as a rich growth of showy ericaceous shrubs. The poor sandy soil is especially adapted to Ericaceæ, and Huckleberries, Azaleas, Kalmias, Rhododendrons, etc., are conspicuous features of the undergrowth. There are also extensive cranberry bogs where many beautiful Orchids occur, as well as Pitcher plants, Sundews and other interesting bog plants. In the coastal bogs of North Carolina grows the unique Venus's fly trap (*Dioncæa*) and the long trumpets of the Southern Pitcher plants.

Over extensive regions of the Gulf states reaching into Texas are extensive forests of Pines, whose value as timber trees is only too well appreciated. The most important of these southern Pines is the long-leaf pine (*P. palustris*).

In the southern portion of the Atlantic states there is an infusion of tropical types, the most striking of which are the Palms, the common Palmetto reaching as far north as the coast regions of North Carolina. Certain genera of unmistakable tropical affinity reach even to the northern states. A conspicuous example is the Paw-paw (*Asimina*), a representative of the characteristic tropical family of Custard-apples. In the Gulf states there are many examples of plants of tropical affinities, including certain Orchids and members of the Pineapple family, of which the most familiar example is the Spanish moss, *Tillandsia*.

The southern part of Florida is very different in its flora from the northern portion, which is essentially the same as that of the other Gulf states. The southern extremity of Florida together with the Florida Keys really belongs to the West Indian floristic region. This is the only part of the United States which has a

real tropical flora. Along the coast there are extensive Mangrove swamps and the strand flora includes many West Indian types. Among the strand plants is the ubiquitous *Ipomœa pes-capræ* found on every tropic beach throughout the world. Another very widespread tropical plant occurring in the swamps along the shore is the stately fern *Acrostichum aureum*. This is also a common and conspicuous plant in the Nipa swamps of the East Indies.

A feature of southern Florida is the presence in the grassy lands of the everglades and in the dry sandy pine forests, of areas covered with hardwood trees. These wooded areas are known as "hammocks," and the vegetation, both the trees and lower growing plants, are mainly tropical types, for the most part West Indian species. There are many epiphytic Orchids and Bromeliads as well as tropical species of ferns, Palms, Figs, Mahogany and other West Indian types. In this region is found the only Cycad (*Zamia floridana*) occurring in the United States.

Proceeding westward, the rich forest vegetation of the Atlantic Gulf states and the eastern Mississippi Valley begins to thin out with the falling off in the rainfall toward the interior. In western Michigan, Indiana and Illinois there are already encountered open prairies, and the forest is much less luxuriant. Open groves of Oaks, Hickories and Walnuts, the so-called "oak openings," are characteristic formations of this region. Further west these disappear, and the whole country forms a continuous open prairie. How far the formation of the prairie is due to climatic causes, *i. e.*, insufficient rain and cutting winds, and how much is due to compact soil (loess) which often underlies them, and which seems unfavorable for tree growth, is not quite clear; but throughout the prairie region trees are practically confined to the beds of the streams and the sheltered gullies between the hills.

Still further westward the prairie insensibly merges into the semi-arid plains, which end abruptly at the foot of the great barrier of the Rocky Mountains.

Compared with the eastern third of the continent the flora of the great central plains is scanty. Grasses predominate, but there are a good many showy flowers which adorn the prairie in the spring and summer. Conspicuous among these are numerous Compositæ, Rosin Weed, Rudbeckia, Sunflowers, Asters, Golden-rods, and many others.

The western third of the continent is much more varied in its topography than the Atlantic side, and shows a correspondingly greater richness and diversity in its flora, since the climatic differences, due to the extremely varied topography, are much greater than is the case in the eastern states.

Rising abruptly from the plains, the Rocky Mountains form the beginning of the great complex of mountains and deserts that stretches to the Pacific Coast. Unlike the worn-down Appalachian system, the western mountains are extremely rugged, and their much greater elevation, rising above the level of perpetual snow, permits of a true Alpine flora. The region bordering on the great plains is arid and semi-arid, and has a pronounced continental climate, with great extremes of heat and cold and a scanty rainfall.

The lower elevations are mostly destitute of forests except along the water courses and in sheltered cañons. Higher up the precipitation increases, and at elevations of from five to ten thousand feet a fairly heavy forest is found, in many places composed mainly of coniferous trees. Of these the most important are the Rocky Mountain Yellow-Pine, the Douglas Fir, the Lodge-pole Pine and Engelmann Spruce. At the lower elevations where trees are found they are mostly of Eastern species, some of which, like the White Elm and Cottonwood, are found sparingly as far west as the base of the Rockies.

For the most part, however, the Rocky Mountain flora is allied to that of the Pacific Coast and the arid southwestern region whose plants are mainly of Mexican origin. A marked feature of the eastern Rocky Mountains is the formation of beautiful glacial parks, which are especially well developed in Colorado. The floors of these parks are covered with a rich carpet of grasses and showy flowers, and the mountainsides support a fairly dense growth of Pines and Spruces with a few deciduous trees like the Aspens and Birches. To the west of the main range of the Rockies lies the elevated arid plateau of the Great Basin, including most of Nevada, Utah, northern Arizona and New Mexico.

This region especially the southwestern portion is one of the most interesting botanical areas of the continent. It is continuous with the Mexican plateau which seems to have been the center of development for the many interesting and peculiar xerophytic types which are so remarkably developed in this region. Among these the Cacti take first place, an almost exclusively American

family. Other striking and characteristic forms are *Yucca*, *Agave*, *Mesquit* (*Prosopis*), the *Creosote-bush* (*Larrea*), the *Ocotilla* (*Fouquiera*) and several other characteristic American genera. This peculiar xerophytic flora is especially well developed in southern Arizona, and visitors to Tucson have an excellent opportunity of seeing it in great perfection.

In the northern part of the Great Basin region the Cacti are almost entirely absent and the desolate country is covered by Sagebrush, Greasewood, and many scrubby *Compositæ*, producing a landscape that is monotonous in the extreme.

In the northwestern area, through Canada and the northern tier of states, the true desert is practically absent, and the mountains are covered with a heavy growth of timber mostly made up of western *Conifers*. The other plants are largely subarctic and northern types, but mingled with these are a good many western genera, such as *Pentstemon*, *Fritillaria*, *Gilia*, and others.

On the western slope different conditions prevail and the ameliorating effects of the west winds from the Pacific make themselves felt. This is, however, not fully seen until the last of the mountain ranges is reached, the great Cordillera, which stretches practically without a break from Alaska to Patagonia. It is this great barrier, averaging in California some ten thousand feet in height, that largely determines the character of the Pacific Coast climate. Protected entirely from the sudden changes of the great interior continental area, with prevailing westerly winds from the vast Pacific whose temperature scarcely changes from one year's end to the other, the whole western coast enjoys an extraordinarily equable and temperate climate.

On the Pacific Coast topography is a far more important factor than latitude in determining climate. Close to the coast the climate is uniformly cool, and seldom either hot or cold. San Francisco in latitude 37°, with an annual mean temperature of 56° F., shows a range of scarcely ten degrees between the hottest and the coldest months. Sitka, 20° farther north, has a winter temperature about the same as that of New York City. Naturally the character of the climate has affected the vegetation profoundly, and with the great differences in elevation and precipitation found along the Pacific Coast, the variety of the vegetation is much greater than in Atlantic North America.

The coast of Alaska, as far north as about sixty degrees, has a winter temperature about the same as that of the middle

Atlantic states, but with a very heavy precipitation, so that it supports an extremely dense forest of large coniferous trees, of which the Tideland or Sitka Spruce (*Picea Sitchensis*) and the Hemlock (*Tsuga Mertensiana*) are the predominant trees. There is an impenetrable jungle of undershrubs and herbaceous plants of almost tropical luxuriance.

Further south the Sitka Spruce is largely replaced by the Douglas Fir, the characteristic tree of the coast region about Puget Sound and northern Oregon. This tree rivals the California Redwoods in height though not in bulk. At the lower levels of the coast in Washington and northern Oregon the forest over large areas is composed almost exclusively of this species, but back from the coast at the higher levels this is to considerable extent replaced by Pines, Firs and Hemlocks. This change in the forest is very clearly shown on the slopes of Mt. Rainier.

The undergrowth of this northern forest is very much like that in Alaska. Among the characteristic species are *Rubus Nutkanus*, *Rubus speciosus*, several species of Elder, the Vine-leaved Maple (*Acer circinnatum*) and the Devil's-club (*Echinopanax horridum*). At the lower levels Alders and Poplars of large size are common along the streams, and with these are found the Big-leaved Maple (*Acer macrophyllum*). Where the forest has been destroyed, especially in burnt-over areas, the ground is covered in mid-summer with a sheet of pink flowers of the Fire-weed (*Epilobium angustifolium*), Bracken ferns of gigantic size and the striking Aroid, *Lysichiton Kamtchatcense*, give a tropical aspect to the dense undergrowth. Most of the herbaceous plants are northern types, Linnæa, Oxalis, Smilacina, Clintonia, *Cornus canadensis*, etc.

At an elevation of about five thousand feet there begins an Alpine flora which is especially well developed on the higher snow-capped mountains of the Cascades and the Canadian Rockies. On Mt. Rainier, where the line of perpetual snow descends to but little over six thousand feet, the close turf, left uncovered for a couple of months after mid-summer, is covered with masses of brilliant flowers of great variety and beauty. Among the most striking of these are two heathlike plants, *Bryanthus* and *Phyllodice*, a very large and beautiful Erythronium (*E. montanum*), a splendid crimson Castilleia, bright blue Lupins, Veronica, white Valerian, several species of Pedicularis, Anemone, Mimulus, Gentian, and many others.

Passing southward from Oregon into California, the outer coast mountains from the Oregon line to Santa Cruz, some fifty miles south of San Francisco, are dominated by the Redwood (*Sequoia sempervirens*), the tallest of all trees, which reaches its greatest development in the northern coast counties of Mendocino and Humboldt. These giant trees occur only in the narrow belt within reach of the heavy summer fogs which prevail along the coast. In most parts of the Redwood belt there is a greater or less mixture of other trees, *e. g.*, Madroño (*Arbutus Menziesii*), the Tan bark Oak (*Quercus densiflora*) the Douglas Fir, wild Nutmeg (*Torreya californica*), the wild Bay tree (*Umbellularia*) and the big-leaved Maple.

South of San Francisco there is a rapid diminution in the rainfall and the Redwoods gradually disappear and are replaced by more xerophytic types. Some of these, like the Monterey-Pine and Cypress and the Torrey Pine of Southern California, are of very restricted range, forming scattered forests along the coast, and extending down to the very edge of the ocean.

Many of the plants of the Redwood belt are northern types which thrive in the cool forests of the outer coast range. Representing familiar northern and southern genera may be mentioned species of violets, Trillium, Clintonia, Oxalis, Smilacina, Asarum, Aquilegia, Delphinium.

Of characteristic shrubs of this region there may be cited species of Ribes, Ceanothus, Gaultheria, Rhododendron, Azalea, Vaccinium, Rubus and Arctostaphylos. In middle California these northern plants follow the shady cañons almost to the level of the valleys, where they mingle more or less with the valley flora which is comprised mostly of strictly Western types.

In many places along the Coast there is an extensive development of sand dunes, which support a very rich and interesting flora. Characteristic plants of the sand dunes are species of Abronia, Lupinus, Erigeron, Enothera, Eschscholtzia, Fragaria, Mesembryanthemum.

In middle California three ranges of mountains parallel with the coast are found. The Outer Coast-range skirts the ocean, and a break in this at San Francisco forms the Golden Gate, opening into the Bay of San Francisco, which receives the united waters of the two rivers draining the great central valley. The latter is separated from several smaller valleys to the west, the most important being the Santa Clara Valley, by the inner Coast

Range which farther south joins the outer Coast Range. The rainfall in these valleys shut off from the ocean by the intervening mountains is relatively small, and the floors of the valleys are usually open plains with only a scattered growth of spreading trees, mostly Oaks. In the great central valley much of the land is too dry to support any tree growth and there are extensive grassy plains recalling the prairies of the Middle West.

The open valleys and the foothills are the home of an extraordinary variety of beautiful flowers, which in spring spread a gorgeous carpet over the landscape. These flowers are largely annuals which start into growth at the first autumn rains, and flower in the early spring, ripening their seeds and dying with the oncoming of the summer drought. There are also many bulbous plants, some of great beauty like the exquisite Mariposa lilies and Brodiaëas. While some of these valley plants like the California Buttercup and species of Clover are allied to Eastern types, the great majority are western or belong to western and southwestern genera. Representative genera are *Lupinus*, *Orthocarpus*, *Eschscholtzia*, *Nemophila*, *Gilia*, *Platystemon*, *Godetia*, *Clarkia*, and an extraordinary variety of showy *Compositæ*.

A characteristic feature of the hillsides and dry mountain slopes is the "Chaparral," a dense and often impenetrable growth of shrubs of many kinds, scrub Oaks, Chinquapin, Poison-oak (*Rhus*), Buckeye, *Ceanothus*, *Ribes*, *Heteromeles*, *Adenostoma*. Most of these are evergreen, but some like the Buckeye and Poison-oak, are deciduous.

To the east of the great valley lies the Sierra Nevada, rising to an altitude of nearly fifteen thousand feet with a flora of great variety and beauty. The lower slopes covered with chaparral and with scattered Oaks and Digger Pines (*P. Sabiniana*) give way at higher altitudes to perhaps the finest coniferous forests in the world. At an altitude of about four to six thousand feet is the great forest belt where grow the scattered groves of the Giant Sequoia, associated with hardly less imposing Sugar Pines, Yellow Pines, Firs and Incense Cedar. As an undergrowth there are found Dogwoods, Oaks, Aspens, and many beautiful flowering shrubs like the Azaleas, *Ceanothus*, *Philadelphus*. The low meadows near the water courses are full of showy flowers, Lupins, Castilleja, Lilies, *Veratrum*, Monk's-hood, Larkspur, and many others.

In the chaparral may sometimes be seen the magnificent Washington-lily and the stately Humboldt-lily, while under the shade of the great Conifers the vivid crimson Snow-plant (*Sarcodes*) may often be found.

Southern California is largely a desert region, the transverse Tehachapi range of mountains shutting it off from the great central valley to the north. The Mojave desert, south of the Tehachapi, is an arid plateau whose scanty vegetation is of a marked xerophytic type. Cacti are abundant and the most striking plants are the tree Yuccas (*Y. arborescens*). Other species of Yucca with magnificent panicles of white flowers also occur, flowering in the late spring and early summer. Farther south there are rich valleys opening toward the sea, and less arid than the tableland to the north, and the Colorado desert to the southeast. The latter region, which includes Death Valley, is a desert of the most pronounced type, some of it lying below sea level, and extremely hot and dry. Opening into the Colorado desert, however, there are small cañons with permanent streams coming down from the lofty mountains, and supporting a more or less mesophytic growth of Cottonwoods, Sycamores and Willows, and in some of the cañons there are imposing groves of the stately Washington Palm (*Washingtonia filifera*). This southern region is really part of the great Sonoran region of Mexico and its vegetation is essentially the same.

The remarkable range in conditions often within very short distances, *e. g.*, the eastern and western slopes of the Coast ranges, results in an extraordinary variation in the vegetation within a relatively small distance, and perhaps no equal area in the world, outside the tropics, can show a greater number of species than California. Moreover, a very large number of these species are endemic and there are also very many peculiar genera. Some of the genera are characterized by a great number of species. Thus the genus *Ribes* (see Harshberger, p. 273) is credited with forty species against thirteen for the whole region covered by Britton and Brown's Manual. Other large genera are *Calochortus*, *Orthocarpus*, *Pentstemon*, *Lupinus*, *Trifolium*, *Gilia*.

Professor L. R. Abrams has kindly furnished the writer with some data showing the remarkable endemism of many California genera. Of the forty known species of *Ceanothus* thirty occur in California, and twenty-five of these are endemic. *Sidalcea* with a total of nineteen species is represented in California by

seventeen, of which thirteen are peculiar. California has some sixty species of *Lupinus*, out of a total of about one hundred described species, and of these forty-five are endemic. More than half of the known species of *Gilia* occur in California and more than half of these (thirty-four out of fifty-seven) are endemic. Many other cases could be cited but these will suffice to show the extraordinary degree of endemism exhibited by the flora of California.

The remarkable development of coniferous trees in California is of course famous. Within the state are nearly twice as many species of coniferous trees as in the whole region east of the Rocky Mountains. Moreover, a considerable number of these species are quite peculiar to the state, and often of very limited range, as for example the Big Tree and the Monterey Pine and Cypress.

While the flora of Oregon and Washington has much in common with the Rocky Mountain region, and even with the Atlantic states, the northern elements are much less prominent in California, although owing to the southward trend of the mountains, many northern types reach far southward, especially in the cool, moist forests of the outer Coast range, where such northern genera as *Trillium*, *Oxalis*, etc., are abundant. There is a certain number of types which seem to be of Asiatic affinity, *e. g.*, *Fritillaria*, *Lysichiton*, and Tan-bark Oak, but in the drier regions the plants are for the most part allied to Mexican and South American forms. Of the latter there are certain species belonging to Chili and Argentina which also occur in California, but are absent from the intermediate territory.

An interesting feature of the Pacific flora is the occurrence of certain genera belonging to the Mediterranean region, *e. g.*, *Arbutus*, *Cupressus*, *Lavatera*, and there are also a few Old World Ferns and Liverworts which are absent from Eastern North America. Of the latter we may cite *Woodwardia radicans*, *Equisetum telmateia*, *Targionia hypophylla*. The survival upon the Pacific Coast of these latter types, which are probably old ones, is presumably due to climatic reasons, and perhaps this explanation may apply to the occurrence of the phænogamic genera as well, a case comparable to the many correspondences between the flora of eastern Asia and that of Atlantic North America.

Only a small part of North America lies within the tropics,

and much of this is so elevated that the flora is not really a tropical one. The whole of the interior of Mexico is an elevated tableland, with a flora closely resembling that of the southern and southwestern United States.

The eastern coast of Mexico, together with Central America and Panama, possesses a tropical flora belonging with that of South America. In this region Palms, Aroids, Cannaceæ, Bombacææ, arborescent Leguminosæ, and other tropical types abound, and there is a very rich development of epiphytic Orchids and Bromeliads.

The extreme southern part of Florida, as we have seen, is the only part of the United States which properly belongs to this tropical area, although a good many Southern types extend much farther north than this. Such Southern types are the Palmettos, *Tillandsia*, and other Gulf-state species.

While the eastern coast of Mexico has a humid hot climate with the typical tropical flora, the western coast is extremely arid with a scanty xerophytic vegetation.

The West Indian region is treated by Dr. Harshberger as a distinct province. There is developed here a rich and interesting flora, allied, as might be expected, to that of the American mainland, but comprising many peculiar species. The larger islands are very mountainous and great differences in the vegetation conditioned by topography may occur within very short distances. This is well illustrated in Jamaica, where the vegetation on the north and south sides of the island is very different, although only forty miles apart. This difference is caused by the presence of a range of mountains over seven thousand feet high in the middle of the island. Jamaica is remarkable for the great development of Ferns, being perhaps the richest area of its size in the world. It is said that some five hundred species occur in the island, which has an area of only about four thousand square miles.

Dr. Harshberger's handsome volume is illustrated with a profusion of excellent figures, many of them original photographs, which add greatly to the value of the book, which must remain for a long time to come the standard work on the distribution of the plants of North America.

DOUGLAS HOUGHTON CAMPBELL

STANFORD UNIVERSITY,  
December, 1911